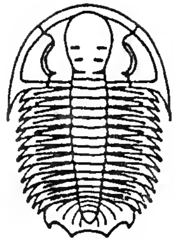
THE FOSSIL COLLECTOR



BULLETIN Nº 40 MAY 1993

'Eric', the Early Cretaceous opalised pliosaur
from Coober Pedy, South Australia (see page 3)

Published by
THE FOSSIL COLLECTORS ASSOCIATION OF AUSTRALASIA

ISSN 1037-2997

FOSSIL COLLECTOR'S ASSOCIATION OF AUSTRALASIA

SECRETARY
F. C. Holmes, 15 Kenbry Road, Heathmont, Victoria, 3135. (03) 7290447

REPRESENTATIVES

AUSTRALIAN CAPITAL TERRITORY
Mrs. M. Webb, Fairlight Stn., R.M.B. 141, Weston, 2611. (062) 365123

NEW SOUTH WALES
Eric Nowak, 29 Bungalow Rd., Roselands, 2196. (02) 7581728

QUEENSLAND
Ian Sobbe, M/S 422, Clifton, 4361. (076) 973372

SOUTH AUSTRALIA
John Barrie, 1 George Terrace, Coonalpyn, 5265. (085) 711172

TASMANIA
John Fennell, R.S.D. 533, Allport St., Leith, 7315. (004) 282543

VICTORIA
Frank Holmes, 15 Kenbry Rd., Heathmont, 3135. (03) 7290447

WESTERN AUSTRALIA
Mrs. L. Schekkerman, 3 Pascoe St., Karrinyup, 6018. (09) 3416254

CONTENTS

EDITORIAL NOTES

PROPOSED NEW QUEENSLAND FOSSICKING ACT

The Queensland Department of Minerals and Energy has advised us that they are seeking Cabinet approval to prepare a new Fossicking Act to replace the present Mining (Fossicking) Act 1985-90. While this is primarily designed to simplify legislation controlling recreational and tourist activities associated with collecting gems and minerals and separate it from that controlling commercial activities administered

under the Mineral Resources Act, two major proposals will be of concern to fossil collectors

Firstly, the definition of "fossicking material" could include fossil specimens, (which has not been the case in the past), and secondly, approval to collect on occupied land will require the collector to hold a Fossicking License and obtain such approval from the owner in writing. Unfortunately it was not until the end of January that we became aware of the above proposals, some nine months after an Options Paper had been prepared. This made it impossible for the FCAA to obtain individual comments from members. However a letter has been sent to the Department of Minerals and Energy addressing some aspects of the proposals which could be of concern in the future, particularly the requirement for obtaining written approval before collecting on privately owned land. We will keep you advised of further developments.

PROPOSED AMMENDMENTS TO THE PROTECTION OF MOVABLE CULTURAL HERITAGE ACT 1986

We have also been advised by the Department of the Arts, Sport, the Environment and Territories, that work by the team reviewing this legislation has been completed, although it is still to be considered by the Federal Government. One of the major changes proposed is the removal of the export permit exemption for palaeontological specimens having a value of less than $1,000. This will mean that every person exchanging or trading Australian fossils with overseas collectors will have to obtain an export permit, even for the most common specimens. To assist in the implementation of this requirement, a decentralised permit issuing system is proposed where appropriate officers of State or Territory museums would assess palaeontological objects proposed for export. This in effect is what was required under the Customs (Prohibited Exports) Regulations prior to 1986, although few people would have been aware of the fact or, even if they were, took any notice.

Assuming the revision comes into force, one question which springs to mind is:- Who will be responsible for seeing that the fossils approved for export are in fact the ones sent out of the country? Will Museum Curators have to seal the material and oversee dispatch? The other problem would appear to be the assumption that a new species or a specimen from a previously unrecorded locality or geological time period will be recognized if it belongs to a group with which the appropriate officer is unfamiliar. Will he have to find someone (more than likely interstate) to verify that the material is not of scientific importance? If the scheme is to work as proposed, it will need to rely on the knowledge and honesty of the exporter - amateur collector, dealer or even researcher! Unfortunately, when we became aware of the review, it was too late for any additional submissions to be made.

A GUIDE TO THE FOSSILS OF THE GINGIN CHALK (2nd edition - revised).

The above booklet, first issued in 1991 (see Bulletin 35, p.14), has now been revised to include a four page section on vertebrate fossils by John Long. Orders should be addressed to Dr K. J. McNamara, Department of Earth and Planetry Sciences, W. A. Museum, Francis Street, Perth, Western Australia 6000. Cost $3.50 incl. postage.

DEADLINE FOR THE NEXT ISSUE

Material for the next issue should be submitted by 23rd. August, 1993, unless otherwise arranged with the Editor.

SAVE 'ERIC' APPEAL

Most of you will now be aware that the purchase by the Australian Museum, Sydney, of the opalised pliosaur named 'Eric', the subject of the recent appeal for funds on ABC TV (Quantum, 28 April, 5 & 12 May, 1993) has been successful. Over $300,000 in donations have been received from around Australia, not only guaranteeing continued

SAVE 'ERIC' APPEAL (Cont.)

public display but also its retention in this country. **On behalf of members, the FCAA made a donation of $250 early in the appeal.**

The Early Cretaceous fossil pliosaur was discovered in mid-1987 by an opal miner at Coober Pedy, South Australia. In 1988 the remains were brought to Sydney by an opal dealer who enlisted the assistance of the Palaeontology staff of the Australian Museum as consultants. The specimen was later purchased privately for possible display in a city development, although the difficult task of cleaning and reconstructing the shattered specimen was entrusted to the Museum.

It took over 450 hours of painstaking work to remove the rock from the numerous bone fragments and to reassemble them. All of the origional bone in the pliosaur's skeleton had been completely replaced by opal, mostly of a poor quality white variety, a type of preservation unique to Australia. The results where spectacular, most of the skeleton (85-90%) was recovered and successfully rebuilt. The fragile skull came out in pieces from four separate blocks of rock. Inside the pliosaur's rib-cage lay piles of smooth, round pebbles or gastroliths (stomach-stones). Mixed in with them were a dozen tiny fish vertebrae, also opalised, the remains of the animals last supper. Preliminary studies reveal this pliosaur, a fast swimming marine predator with numerous sharp teeth, to be related to a form known as Peyerus found in South Africa over 60 years ago, in rocks of approximately the same age. However, the Australian animal probably represents a new species.

FINANCES

Income and expenditure for the Financial Year, 1st March, 1992 to 28th February, 1993 (previous year's income and expenditure shown in brackets).

INCOME			EXPENDITURE		
Subscriptions			Postage	908.38	(809.07)
current	1147.00	(780.50)	Printing	568.65	(656.85)
advance	776.33	(696.65)	Photocopies,		
Donations	24.60	(27.09)	photo's & bromides	174.60	(221.05)
Advertising	30.00	(-)	Stationery	71.14	(120.85)
Bank interest	62.43	(45.86)	Sundries	170.51	(126.75)
Sale of Bulletins	217.15	(130.10)	State Rep. expenses	56.69	(56.69)
Miscellaneous	-	(5.00)	Subscriptions	-	(-)
Overpayments	-	(7,50)	State/Fed. tax	3.87	(3.56)
			Miscellaneous	-	(17.42)
			WP purchase (50%)	22.50	(-)
			Refunds	-	(7.50)
	$2,257.51	(1,692.70)		$1,976.34	(2,019.74)

Balance at 28th February, 1993		
Brought forward from	1991/1992	$1,830.69
Add income	1992/1993	$2,257.51
		$4,088.20
Less expenditure	1992/1993	$1,976.34
		$2,111.86

When the above figures are adjusted to include 1992/93 subscriptions paid in 1989/90, 1990/91 and 1991/92 ($743.81) and to exclude 1993/94 and 1994/95 subscriptions paid in advance ($776.33), income for the Financial Year 1992/1993 exceeded expenditure by $248.65 compared with a deficit of $66.01 for the previous year. After deducting total advance subscriptions of $788.83 from the balance in hand at 29th February, 1992, we are left with a nett reserve of $1,323.03 ($1,068.44).

PRESERVING THE REDBANK PLAINS FOSSIL SITE: AN INTERIM REPORT.

Alan Rix, Brisbane.

All too often our geological heritage disappears before our eyes under the bulldozers of developers. The fate of Middendorp Quarry (Jell 1992) is a case in point. Australia is perhaps fortunate in that many of its important fossil deposits are well away from the threat of man-made destruction. However, the Redbank Plains site in Southeast Queensland is in the midst of Australia's fastest growing urban area, where the population of 1.9 million may double by 2025 or 2030. I have reported previously in this journal (Nos 32/33 and 36) on fossil finds from the Palaeocene-Eocene site at Redbank Plains. This article deals with efforts over the last twelve months to ensure that the Redbank Plains site is preserved when the landholding on which it is located is developed in the near future. This process has not been completed, and there are a number of administrative hurdles to jump yet, but FCAA members may be interested in an interim report.

Moreton Shire, in which Redbank Plains is located, borders the southwestern fringes of Brisbane City. It includes the suburban areas of Goodna and Camira, takes in the southern outskirts of Ipswich and a large rural belt south from Ipswich, including Boonah and surrounding areas. Given the projected huge increase in population in this and surrounding shire (Moreton's population is expected to nearly triple by 2006), extensive housing development is now taking place in what was previously bushland area. The new town of Springfield is mushrooming on a large site previously used for selective logging, only a few kilometres to the east, and the western perimeter of the Springfield site abuts land on which fossils have previously been found (Hills, 1934). That holding is itself now being turned into a golf course.

The land on which the main Redbank Plains fossil outcrop is located has for a few years been slated for development. It is across the road from existing acreage development, and the pattern of population pressure meant that it was only a matter of time before the 300 or so hectares was turned over to housing. Other parts of the fossil zone in the surrounding suburb had been buried under housing some years ago, so this site is the last remaining outcrop. It is also the only major vertebrate fossil site left in the Brisbane area.

PRESERVING THE REDBANK PLAINS FOSSIL SITE (Cont.)

Twelve months ago, an ad-hoc group of interested local naturalists proposed to the Queensland Minister for Environment and Heritage that the site be set aside as a scientific reserve, and thus protected from development. This was done with the full support of the owners of the land, and we gained the endorsement of the then Minister, Mr. Comben. Since that time, the owners have had the fossil site formally surveyed and identified on the plans as a separate lot, the Council has indicated its inprinciple agreement to the concept, local schools and interest groups are on side, and the Queensland Museum and the University of Queensland are able to be involved in a future management committee.

So far, so good. The land is in the process of being sold to a development company, and provision needs to be made in the process of development approval for the fossil area to be set aside. These technicalities are still to be overcome, and we are mindful of the possible problems. At this stage, we are very fortunate in being able to deal with landowners who have given constant support, including the provision of a full survey of the site. Having an important fossil site taking up about 12 hectares of one's land could be regarded by many as a nuisance; in this case, however, we could not have advanced this far without the assistance of the owners. Likewise, the previous and present Ministers of Environment and Heritage and their Department, as well as the Queensland Museum, have provided personnel and advice. It suggests that one has to be lucky to have the right combination of circumstances to achieve preservation of a site such as this.

If the Redbank Plains site can be made into a scientific reserve, it will mean that an important early Tertiary locality remains accessible for study. The wide range of as-yet undescribed invertebrate remains that have been recovered from the site, new specimens of the already well-known fish, and other vertebrates that are appearing, can be available for systematic research if the site is retained in its present form.

I hope to be able to provide a full report on the site's successful preservation in a later issue of **The Fossil Collector**, if all the administrative details that lie ahead can be dealt with.

References

Hills, E. S., 1934. Tertiary Freshwater Fishes from Southern Queensland. **Memoirs of the Queensland Museum** 10(4): 157-182.

Jell, P. A., 1992. Middendorp's Quarry: A classic Australian Early Devonian fossil site. **The Fossil Collector** 38: 7-16.

BRIEF HISTORY OF THE PALAEONTOLOGICAL COLLECTION IN THE MUSEUM OF VICTORIA

Thomas A. Darragh, Museum of Victoria, Melbourne, Australia.

The National Museum of Victoria (now the Natural Sciences Division of the Museum of Victoria) was founded in March 1854 when a small collection of zoological and geological specimens were collected together and housed in two rooms of the Government Assay office in LaTrobe Street. William Blandowski a Prussian mining engineer was appointed Zoologist and Curator of the Museum.

From the point of view of this article, the most important geological specimens to come into the infant museum were those collected by Alfred Selwyn, the Government Geological Surveyor. Selwyn arrived in Victoria in November 1852 and undertook several reconnaissance surveys before the Geological Survey of Victoria was put on a formal footing in 1856. The specimens from these reconnaissance surveys were deposited in the Museum.

In 1855, owing to cuts in the public service, the museum was threatened with closure and the rooms in the Assay Office occupied by the Museum required for building renovations. Frederick McCoy, Professor of Natural Science at Melbourne University, then offered to house the collections in the planned University Museum. This offer was taken up by the Government and the museum was set up in four rooms on the first floor on the north wing of the University building. McCoy was appointed Honorary Director in 1858 as well as having been appointed Palaeontologist to the Geological Survey. From 1856 to 1868, when the Survey was disbanded, all Geological Survey specimens were lodged in the Museum. The bulk of the material collected at that time consisted of fossils which were the most important specimens scientifically and formed the basis for much of the taxonomic work undertaken by McCoy and later by the Museum's palaeontologist, Frederick Chapman.

From 1857 through to about 1870, McCoy built up the reference collections of overseas fossils and minerals by purchase from dealers and collectors principally in England but a vast quantity of specimens were also purchased from Albert Krantz in Bonn.

Some of this material is of considerable scientific importance as it included type and figured specimens and it is probable that more types remain unrecognised.

PALAEONTOLOGICAL COLLECTION IN THE MUSEUM OF VICTORIA (Cont.)

The principal fossil collections purchased from overseas by McCoy in the period 1859 to 1899 are as follows :-

Robert Damon and his son **R. F. Damon** of Weymouth. Material purchased from 1861 through to 1899. It includes Mesozoic mollusca, Palaeozoic fishes and Mesozoic ichthyosaurs. Much of this material is first class and especially suitable for display.

Charles Darwin. A few fossil barnacles described and figured by Darwin were present in the Morris collection purchased from A. Krantz in 1863.

Thomas Davidson. A few fossil brachiopods described by him were present in the Morris collection purchased from Krantz in 1863.

James Harrison. A portion of his collection was purchased by the Geological Survey Museum in London in 1861 and the National Museum purchased the remainder through the dealer Robert Damon. It includes mostly Jurassic cephalopods, some crinoids and reptile remains.

Charles Ketley. 91 Wenlock (Middle Silurian) fossils from Dudley were purchased in September 1862.

A. Krantz of Bonn. A large quantity of material was purchased from him in the period from 1860 to 1868. Includes the odd type specimen but is mostly useful reference material from European localities - Cambrian to Tertiary.

F. Koch of Gustrow, Germany. His entire collection of Tertiary mollusca was purchased in 1880. It includes some types and much of the material mentioned in his papers and those of Beyrich and von Koenan on the north German Oligocene.

Alfred Marston of Ludlow. A small collection of Late Silurian fossils were purchased in July 1862. It may include some of J. Salter's types.

Professor John Morris. His collection was purchased by the German dealer A. Krantz in May 1862 and the museum purchased a large proportion of the Cretaceous and Tertiary material in 1863 and 1865. It contains specimens described by Darwin, Sharpe and Davidson and possibly others as yet unrecognised.

Dr. Murray of Scarborough. Portion (all?) of his Scarborough

Jurassic plant collection was purchased after his death in 1864 from Robert Damon. It includes some types described by Lindley and Hutton.

James Mushen, Birmingham. 400 Dudley specimens were purchased in 1862.

D. Sharpe. A few cephalopods figured in his Palaeontographical Society Monograph were present in the Morris Collection purchased from Krantz in 1863.

Dr. Thomas Wright, Cheltenham. Two large collections were purchased from him in 1862 and 1865. Material includes echinodermata from the British Mesozoic, the Tertiary of Malta and Vienna Basin and Jurassic brachiopods, coral and mollusca from Britain.

John Lycett. A large collection of Jurassic gastropods and bivalves was purchased from him. It includes some specimens figured in Morris and Lycett's monograph on the Great Oolite

Acquisition of rocks and minerals during this period was on a much smaller scale, though most of the material purchased was of first quality and came from many of the now classic localities in Britain and Europe. The principal source of the material was A. Krantz.

In 1870, the Industrial and Technological Museum (now Science and Technology Division of the Museum of Victoria) was founded and this institution took on as part of its role the display of rocks and minerals. This meant that no further acquisitions were made of rocks and minerals in the National Museum until 1899 when most of the collections of the Industrial and Technological Museum were transferred to the National Museum.

It is not intended here to give fuller details of the history of the rock and mineral collections as this had been done by A.W. Beasley 1970, Growth of the rock, meteorite collections in the National Museum of Victoria. Memoirs of the National Museum of Victoria. 32: 1-16.

Following the demise of the Geological Survey of Victoria as a separate entity in December 1868, no geological survey work was undertaken until 1872 when R. B. Smyth, the Secretary of Mines, obtained funds for mapping to be recommenced. McCoy acted as Palaeontologist to the Mining Department and fossils collected

PALAEONTOLOGICAL COLLECTION IN THE MUSEUM OF VICTORIA (Cont.)

in the course of departmental work were forwarded to McCoy for determination and retention in the Museum. This continued somewhat irregularly until McCoy's death in 1899, though in the 1890s certain groups of fossils were sent to other palaeontologists and retained in the Mines Department Collection e.g. T. S. Hall determined graptolites.

In 1902, Frederick Chapman was appointed Palaeontologist to the Museum and the Mines Department sent material to him for determination and retention. This means of acquisition ceased in 1928 when Robert Keble succeeded Chapman as Palaeontologist. Thereafter the Department of Mines maintained their own collections until 1973 when it was decided to transfer the bulk of fossil collections to the National Museum. Only those collections of current interest to the Geological Survey personnel were retained.

So far only two sources of acquisition have been mentioned - purchase and material collected during the course of geological mapping. There are two other important sources of specimens - donations by members of the public and collection by staff. Strange to say the latter was not an important source of material until as late as 1948 when Edmund Gill succeeded Keble. McCoy never collected anything in the field and Chapman and Keble very little.

During McCoy's time, donations of fossils by members of the public was not a major source of material in terms of bulk, though by this means many highly important specimens were received, particularly in the field of fossil vertebrates.

It was not until 1895 that the first local private collection of significance was purchased, reflecting perhaps the lack of interest in geology in the community in the early days of Victoria. This was the polyzoan collection of Dr. Paul Macgillivray who died in July of that year. However, early in the twentieth century several significant private collections were either donated or purchased and such additions have continued to the present day. The most significant collections from Australian scientists and collectors held by the museum are as follows :-

A. N. Carter. A large collection of foraminifera, mostly pelagic forms, from southeast Australia, including photographs and comprehensive indices to the fauna.

Frederick Chapman. Most of his types are held in the Museum

but he also had a large private collection which was split between the University of Melbourne Geology Department and the Bureau of Mineral Resources, Canberra. The University component came to the Museum in 1988.

A. C. Collins. The collection consisting of Tertiary and Recent foraminifera from Australian and overseas localities was donated to the Museum some years before Collins' death.

F. S. Colliver. Most of his large Victorian collection was presented to the Museum in 1962. A significant portion of his collection was given to the Queensland Museum shortly before his death.

I. Cookson. Most of her type material is in the Museum including Palaeozoic plants, Tertiary fungi, Tertiary and Cretaceous spores, pollens and dinoflagellates.

Frank Cudmore. His huge collection of Tertiary fossils from southeastern Australia was donated in 1937. It included the Tertiary component of T. S. Hall's collection and types described by Chapman, Singleton, Ashby and Marwick.

Henry Deane. Fossil plants including some types.

J. Dennant. Tertiary molluscs and Tertiary corals, including his coral types. The Recent corals are in the Invertebrate Zoology collection.

Peter Duncan. A large collection of invertebrates, mostly insects, from the late Cretaceous Koonwarra fish bed. This collection formed the basis of Jell's study of this fauna.

T. S. Hall. His graptolite collection was purchased after his death and included many type specimens. Other Hall types are in the Geological Survey Collections transferred to the Museum in 1973. His echinoid types were in his Tertiary collection purchased by F. Cudmore and subsequently donated to the Museum.

W. J. Harris. Early in his career he donated his types to the National Museum but later to the Mines Department. Some types are alleged to have been lost in a fire at his home. All known types are now in the Museum.

Kyancutta Museum. The remaining collections of this museum were purchased in 1972. Most of the material was the display collection. The Geology Department at A.N.U. had purchased the

PALAEONTOLOGICAL COLLECTION IN THE MUSEUM OF VICTORIA (Cont.)

meteorite and reserve collections some years earlier. Some Etheridge types were found in the collection.

P. H. Macgillivray. All Tertiary and Recent Polyzoa slides in the Museum.

C. M. Mapleston. All Tertiary and Recent Polyzoa slides in the Museum.

Melbourne University Geology Department. All type material and most of the general collections were transferred to the Museum in 1988 and 1989.

Ferdinand von Mueller. All fossil fruits described are probably in the large collection identified by him now in the Museum.

J. F. Mulder. His collection was acquired after his death in December 1921. Chapman described some material from his collection.

Oil company collection. Large collections of microfossils from offshore oilwells deposited by BHP, ESSO, Shell and other companies, deposited under the requirements of various acts of Parliament.

W. J. Parr. Foraminifera types and his collection of bulk samples in the Museum. Further Parr material came to the Museum with the Collins collection.

G. B. Pritchard. His graptolite and Tertiary mollusc types previously in Melbourne University Geology Department are now in the Museum. Other types and his large general Tertiary collection are also in the Museum.

J. Richardson. A large collection of Tertiary and Recent brachiopoda from Australia and New Zealand, with significant comparative material from overseas.

George Sweet. His large and important collection was donated to the Museum. It includes types of species described by Etheridge Dunn, Woodward and Chapman.

G. A. Thomas. A collection of Carboniferous and Permian fossils, mostly brachiopods, from Australia, but including important material from Russia and the United States of America.

WESTERN AUSTRALIA'S TERTIARY FLORAS

Stephen McLoughlin and Lisa Guppy, Department of Geology, University of Western Australia.

Abstract

Early Tertiary plant fossils from southwestern Australia reveal a complex mix of rainforest and heathland species preserved in strongly silicified, bivalve-bearing, fluvial sediments. Palaeoclimate, soil-types, and fluvial sorting probably imposed strong controls on the composition of the fossil assemblages.

Distribution of fossil localities

Tertiary fossil plants occur in scattered outcrops of siliceous sandstone in the Kojonup, Calingiri, and Walebing districts in the southwest of Western Australia. These deposits represent part of the Kojonup Sandstone. Other Tertiary plant impressions and permineralised wood have been recorded at Cape Riche (Chapman & Crespin, 1934), Nornalup, Denmark, The Kalgan River, Twertup, Woogenellup, the Fitzgerald River, Chirgejup, Northcliffe, Tambellup, Kendenup, and Toolbrenup (Churchill, 1973), mostly from exposures of the Bremer Basin's Plantagenet Group. A review by Hill & Merrifield of the flora from a stratigraphically uncertain lateritised deposit at West Dale, near Beverley, is in press (in Alcheringa). McNamara & Scott (1983) described moulds of Banksia cones from the Merlinleigh Sandstone in the Kennedy Ranges, east of Carnarvon. Poorly preserved and fragmentary plant remains occur within lateritic profiles throughout much of the interior of Western Australia. Additionally, carbonaceous plant remains are occasionally exposed in opencut gold and nickel mining operations which intersect Early Tertiary palaeodrainage channels in the Coolgardie-Norseman district (Lange, 1978). Virtually all of the collecting localities mentioned above occur on private land and express permission from the owners is required before visiting the sites. As some of the sites contain very limited assemblages which have not yet been systematically described, donation of these rare plant fossils to institutional collections is therefore recommended. This article deals principally with the plant impressions of the Kojonup Sandstone.

Institutional collections

The chief public collections of Western Australian Tertiary plant fossils reside in the Western Australian Museum and the Geology Department of the University of Western Australia. The Geological Survey of Western Australia holds small collections of fossils from Kojonup and Calingiri briefly examined by Wilde & Backhouse

WESTERN AUSTRALIA'S TERTIARY FLORAS (Cont.)

(1977). Small collections of plant cuticle preparations and thin-sections of silicified wood are held by the Adelaide University Botany Department, the National Herbarium in Melbourne, and the University of Tasmania's Department of Plant Sciences (Churchill, 1973; Lange, 1978; Carpenter, 1993).

Depositional setting

The Eocene Kojonup Sandstone occurs only in isolated outcrops along present drainage divides. The type section unconformably overlies Archaean rocks and consists of strongly silicified conglomerate, sandstone, and white and grey orthoquartzite (Hocking & Cockbain, 1990). A fluvial depositional setting is suggested by the coarse-grained lithology, cross-bedding, the local abundance of terrestrial plant remains, in situ roots, and the presence of non-marine bivalves (Wilde & Backhouse, 1977).

Composition of the Kojonup floras

A histogram (Fig. 41) illustrates the proportional representation of fossil groups presently recovered from two localities near Kojonup. The major plant groups are discussed below.

Angiosperms (flowering plants)

The Proteaceae are well-represented in the Kojonup floras with an abundance of Banksia-or Dryandra-like forms (Figs. 1-7,9) which show varying similarities to modern species. It is virtually impossible to confidently assign fossil foliage of this type to either Banksia or Dryandra in the absence of cuticular information or of attached fruiting bodies. Such fossil leaves are best assigned to the form genus Banksieaeformis. Forms with leaves dissected into triangular pinnules (Fig. 1) are reminiscent of modern species like Banksia speciosa or B. candolleana, while narrow linear forms (Fig. 7) show similarities to species like B. grossa, B. lanata, or B. occidentalis. Yet other fossil leaves have broad laminae with serrate margins (Fig. 5) showing parallels with species like B. burdettii. Grevillea-like, deeply dissected, leaves are also apparent within the fossil assemblages (Fig. 8). Certain other fossil leaves can be less-confidently assigned to the Proteaceae based on their venation styles and cuspate margins (Figs. 10-17). Some of these forms may have affinities with genera like Lomatia, Hakea, Isopogon, and Petrophile. In addition, a number of as yet unidentified spherical and spike-like fruiting bodies (Figs. 35, 36) have probable proteacean affinities.

Another important group in the Kojonup and Bremer Basin floras is the Fagaceae, in this case represented by a species of Nothofagus (the Southern Beech). This genus is now extinct in Western Australia but during the Early Tertiary was widespread across the southern landmasses growing in temperate humid conditions. Churchill (1961) described these leaves under the name N. wilkinsoni (Ettinghausen) Paterson in his unpublished thesis. However, the Kojonup Nothofagus (Fig. 18) appears to be a new and distinctive species with plicate vernation, a feature characteristic of deciduous living species of the genus.

The Casuarinaceae is another abundant family represented by slender stems and stellate-spherical cones (Figs. 19, 23) belonging to a species of Gymnostoma. This genus was, once again widespread across Australia but is now restricted to northeast Queensland and parts of Melanesia.

Certain deeply digitate leaves within the Western Australian assemblages (Fig. 20) show similarities to members of the Sterculiaceae,

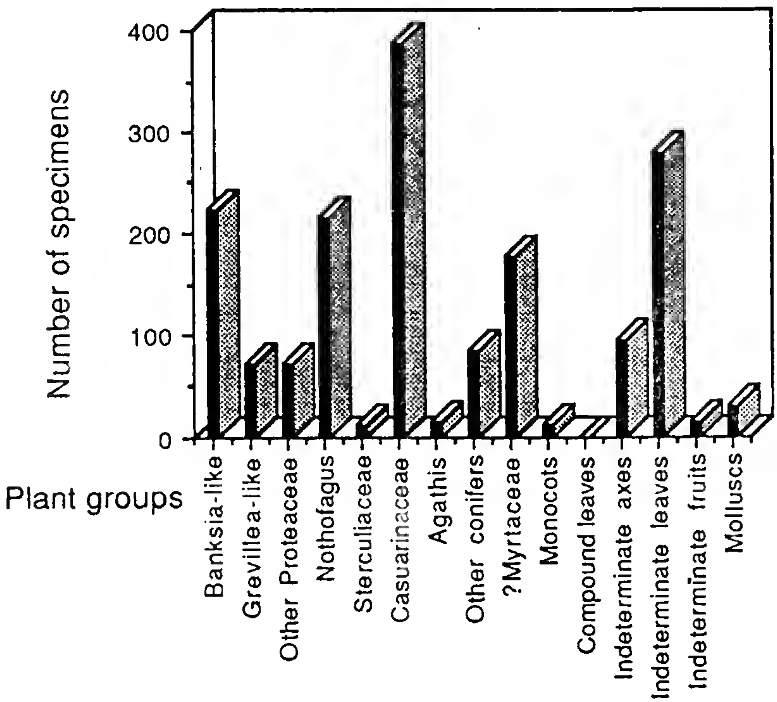


FIGURE 41. Representation of fossil groups collected from the Kojonup Sandstone at Half Moon Farm and Na Laura localities.

WESTERN AUSTRALIA'S TERTIARY FLORAS (Cont.)

notably species of Brachychiton. However, a Proteaceous affinity and links to genera like Stenocarpus are also possible.

Members of the family Myrtaceae including Eucalyptus, Angophora, Callistemon, Melaleuca, Leptospermum, and Syzygium dominate much of the modern Australian forest vegetation. Definitive examples of this group are hard to find within the Kojonup fossil assemblages. However, certain rather featureless lanceolate or falcate leaves with prominent marginal veins (Figs. 24, 25, 27) are possible candidates for inclusion within this group. This is supported by their sporadic occurrence in association with diminutive four-locular fossil fruits having a capped gumnut-like appearance (Fig. 22).

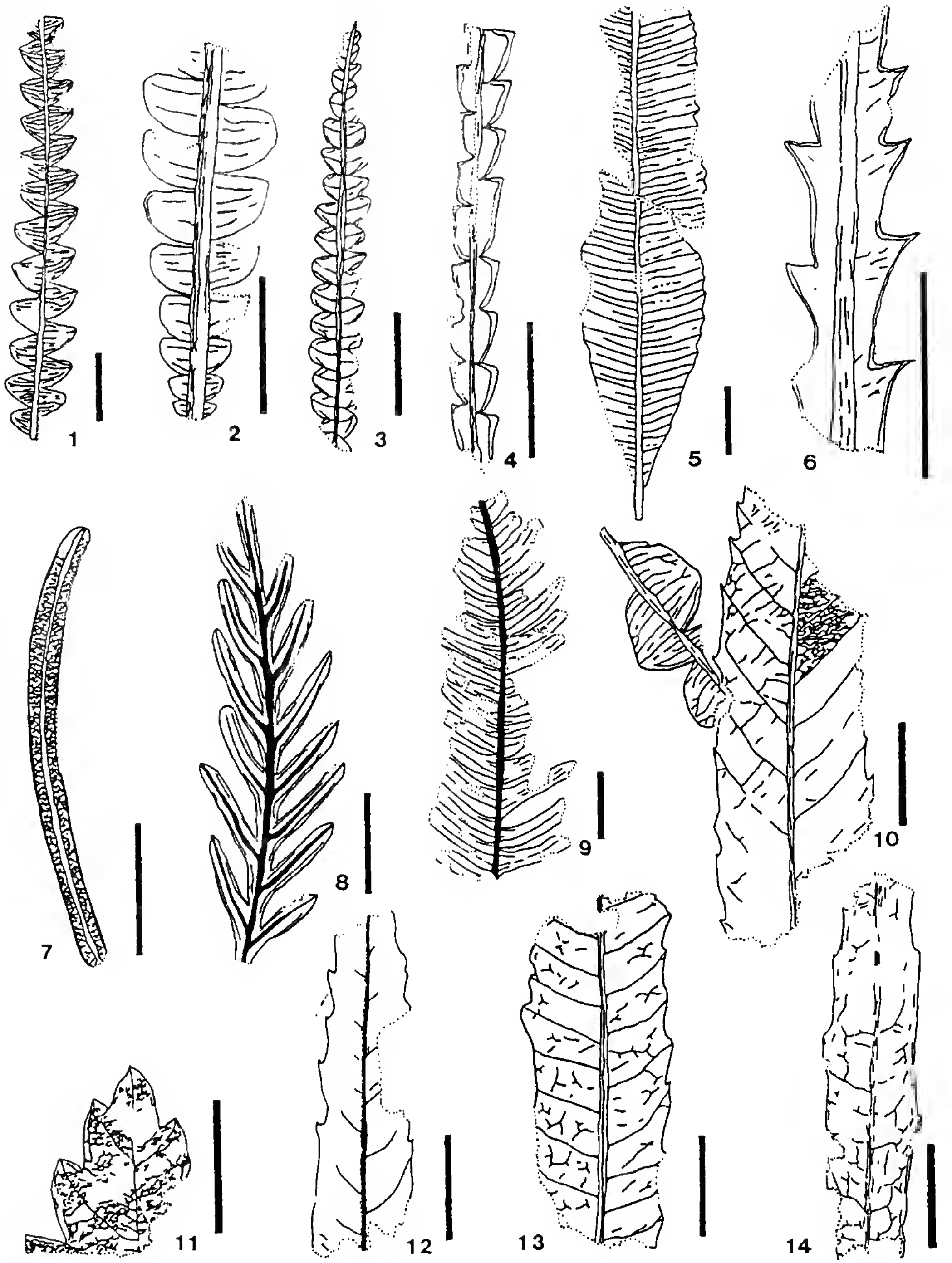
Other dicotyledonous angiosperm leaves in the assemblages are less-easily indentifiable being preserved as moulds and showing only the primary and secondary veins without any epidermal features or associated fruits (Figs. 28, 29). Some may have affinities with the Cunoniaceae (Fig. 21), Lauraceae (Fig. 30) or Leguminaceae (Fig. 26) but investigations of these forms are presently at very preliminary stages. Monocotyledonous angiosperm leaves are relatively rare and identifiable in the assemblages by their linear shapes and parallel venation (Fig. 31). Monocots generally have a poor fossil record as their dead leaves tend to decay while remaining attached to the parent plants.

Conifers

The Araucariaceae includes such modern Australian trees as the Hoop, Bunya, Norfolk Island, and Kauri pines. This family no longer grows naturally in Western Australia but the Kojonup floras contain broad elliptical leaves very similar to modern Agathis (Kauri Pine) species (Fig. 40). Additionally, moulds of small female cones occur at Kojonup (Fig. 33) which appear identical to modern juvenile ovulate Kauri cones.

Phyllocladus (Celery Top Pine), an unusual conifer with minute

FIGURES 1 - 14. Photo-line drawings of Western Australian Eocene proteaceous plant fossils. 1-8, 10-14: Kojonup Sandstone, Na Laura Farm, Muradup. 9: Merlinleigh Sandstone type section, Kennedy Ranges. 1, Banksieaeformis sp. A, leaf comparable to Banksia speciosa; 2, Banksieaeformis sp. B; 3, Banksieaeformis sp. C; 4, Banksieaeformis sp. D; 5, Banksieaeformis sp. E, comparable to Banksia burdettii; 6, Banksieaeformis sp. F; 7, Banksieaeformis sp. G; 8, Grevillea-like leaf; 9, feather-leafed Banksia?; 10, Proteacean sp. A (right) and Banksieaeformis sp. A (left); 11, Proteacean sp. B; 12, Proteacean sp. C; 13, Proteacean? sp. D; Proteacean sp. E. All scale bars = 1cm.


1
2
3
4
5
6
7
8
9
10
11
12
13
14

WESTERN AUSTRALIA'S TERTIARY FLORAS (Cont.)

scale-like leaves borne on the edges of prominently veined rhomboid flattened branches (cladodes), is now restricted to Tasmania, New Zealand, New Guinea, and parts of southeast Asia. Three lamina fragments probably attributable to this genus have been found at Kojonup (Fig. 37). Another Kojonup conifer group has diminutive oppositely arranged scale-like leaves and is possibly attributable to the Cupressaceae (Fig. 39) of which two genera (Callitris and Actinostrobus) survive in the modern southwestern Australian flora. Yet another group with spirally arranged scales (Fig. 34) is possibly allied to the podocarpaceous genus Dacrydium. The absence of associated cones and cuticular detail detracts from accurate assignment of these fossils to a particular genus.

Ferns, lycophytes, and bryophytes

There is a notable absence of fern, lycophyte, and moss macrofossils in the Western Australian Early Tertiary assemblages which may be attributable to the poor preservational potential of their delicate remains in what were relatively high-energy depositional environments. Palynological investigation of Western Australian Eocene sediments has also suggested that pteridophytes made up only a minor component of the parent vegetation (Hos, 1975; Milne, 1988). Currently there are only about 35 surviving pteridophyte species native to southwestern Australia (Clifford & Constantine, 1980) and many of these are restricted to specialised habitats.

Age of the floras

The age of the Kojonup Sandstone is poorly constrained. Most exposures are deeply weathered preventing palynological analysis. The only invertebrates recorded from the unit are unionid bivalves which do not provide good biostratigraphic controls. The Kojonup Sandstone is extremely rich in siliceous cement, a feature typical of many Late Eocene Australian sedimentary rocks in both terrestrial and marine settings. In the adjacent Bremer Basin, for example, siliceous sponge- and diatom-rich beds are developed in the Pallinup Siltstone and Princess Royal Spongolite. The abundance of silica, the unit's geomorphological setting, and floral similarities with certain localities in eastern Australia suggest a Late Eocene age for the Kojonup Sandstone.

FIGURES 15 - 27. Plant fossils from the Kojonup Sandstone. 15-19, 21-26, Na Laura Farm, Muradup. 20, 27, Half Moon Farm, Kojonup. 15, 16, Proteacean sp. F; 17, Lomatia- like leaf; 18, Nothofagus sp.; 19, Gymnostoma twigs and scale leaves; 20, Brachychiton sp.; 21, Cunoniacean? leaf with complex venation; 22, capped cupulate myrtacean? fruit; 23, mould of Gymnostoma fruit; 24, 25, 27, Myrtacean leaves; 26, segmented leguminous cladodes. All scale bars = 1cm.


15
16
17
18
19
20
21
22
23
24
25
26
27

WESTERN AUSTRALIA'S TERTIARY FLORAS (Cont.)

Palaeoclimatic and palaeoenvironmental implications

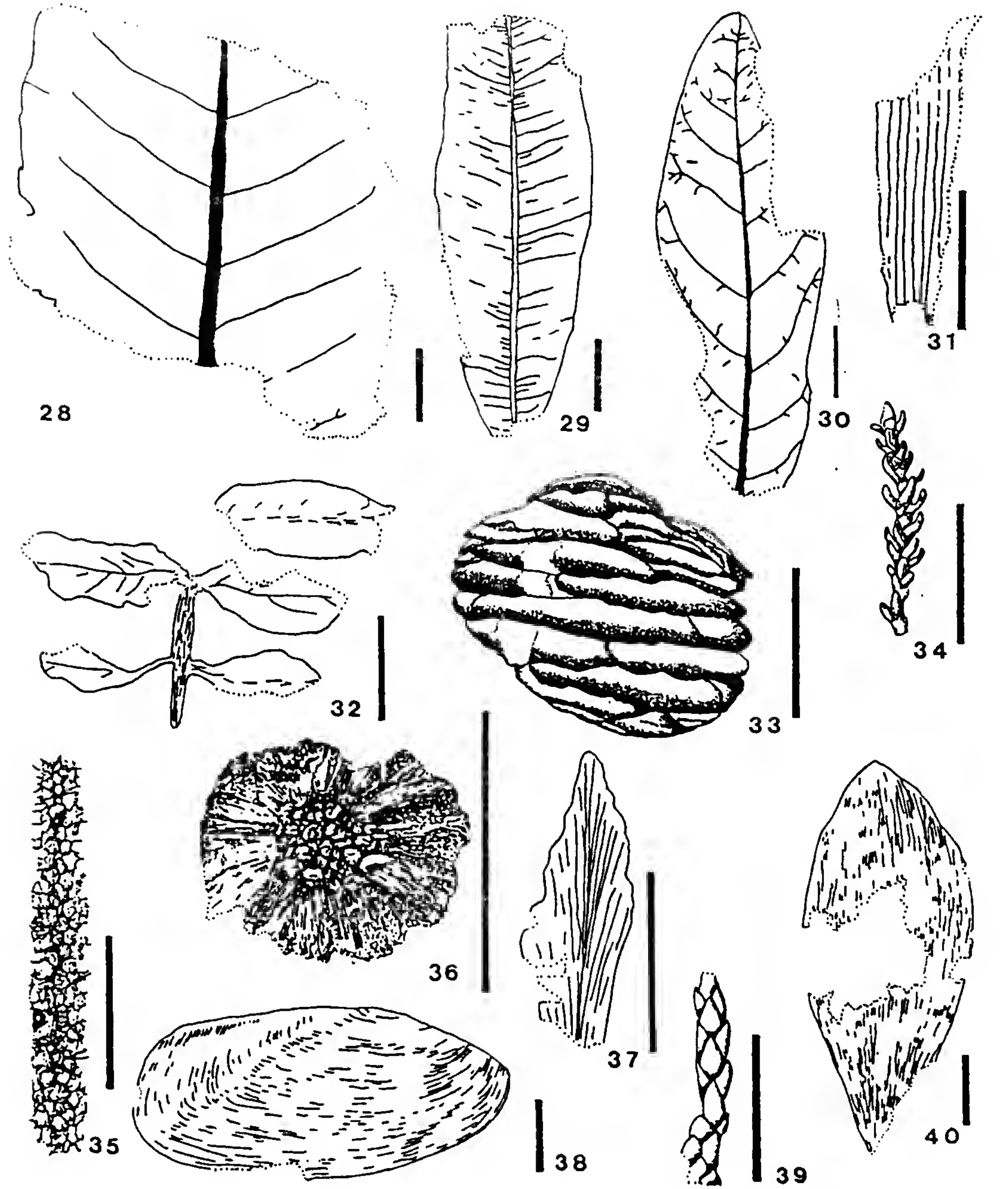
Late Eocene to Early Oligocene times (ca. 38-35 million years ago) saw the final phase in the separation of the Australian and Antarctic continents (Veevers et al., 1991). During this time the southwest of Western Australia lay in latitudes of around 55°-60° south. A temperate climate is therefore likely to have prevailed. However, the occurrence of fossils in the southwest like *Gymnostoma*. *Barringtonia* (Lange, 1978), and mangrove-like pollen (Hos, 1975) suggests a relatively warm climate as these groups are now restricted to tropical regions. Marked cooling of the climates may only have developed following the Eocene break-up of Australia and Antarctica with the development of south circumpolar ocean currents. The Kojonup assemblages include groups traditionally regarded as rainforest or wet-sclerophyll elements (*Agathis* and *Nothofagus*) together with typical heathland taxa (*Banksia*-and *Grevillea*-like forms). The parent flora may thus have been a patchwork mosaic of vegetation types controlled by factors such as soils. A similar vegetation mosaic is seen today in wetter parts of the southwest where stunted *Banksia* heathland grows in intimate association with patches of giant Karri-dominated wet sclerophyll, the sharp boundaries being controlled entirely by subtle changes in soil type and topography.

Relationships with the fauna

Few records are available of the Early Tertiary terrestrial vertebrates within Australia. The only pre-Oligocene Tertiary mammal-bearing fauna is that of Murgon in southeast Queensland (Archer et al., 1991). Consequently little can be said of vertebrate-plant interactions during this period. Additionally, of the >1800 leaves recently collected from the Kojonup Sandstone, few if any show indisputable evidence of insect attack. Rare examples of Kojonup leaves are found with numerous small (<1 mm) circular indentations which may be the scars left by sap-sucking insects or alternatively they may represent oil glands or the bases of leaf hairs. Otherwise, the only animal fossil associated with

FIGURES 28 -40. Western Australian Eocene fossils. 28, Pallinup Siltstone, Cape Riche: 29-31, 34-40, Kojonup Sandstone, Na Laura Farm, Muradup: 32, 33, Kojonup Sandstone, Half Moon Farm, Kojonup. 28, 29, indeterminate broad-leafed dicot angiosperms; 30, Lauracean? leaf; 31, monocot angiosperm leaf; 32, compound leaf; 33, *Agathis* ovulate cone with overlapping bracts; 34, Podocarpacean (*Dacrydium*?) twig with spiral leaf arrangement; 35, 36, Proteacean fruiting bodies; 37, *Phyllocladus* sp.; 38, freshwater bivalve mollusc; 39, Cupressacean (cypress pine) twig with opposite leaves; 40, *Agathis* leaf. All scale bars = 1cm.

the plant remains at Kojonup are moulds of freshwater bivalves (Fig. 38) which show similarities to the modern southwestern Australian freshwater mussel Westralunio ambiguus.



WESTERN AUSTRALIA'S TERTIARY FLORAS (Cont.)

Conclusions

Western Australian Tertiary plants have received scant attention in the past but they have the potential for contributing important information on the evolution of our modern vegetation. The disappearance of rainforest and wet sclerophyll groups (like the Kauri Pines, Southern Beech, and Celery Top Pines) from Western Australia gives us an insight into the past trends and future directions of climate change in that part of the continent. The plant remains represent virtually the only fossils available for age determination of various enigmatic surficial and duricrust deposits in Western Australia. Finally, lignites composed of Early Tertiary plant remains, although not yet economically exploited, occur along the Fitzgerald River and to the north of Esperance. In the future, these may become a valuable local energy source.

References

Archer, M., Hand, S. & Godthelp, H., 1991. Riversleigh. The Story of **Animals in Ancient Rainforests of Inland Australia.** Reed Books, Balgowlah, NSW., 264 pp.

Carpenter, R. J., 1993. Proteaceae cuticles and aspects of the fossil history, phylogeny and ecology of the family. In, Hill, R. S., ed. **Abstracts, Conference on Southern Temperate Ecosystems: Origin and Diversification.** Hobart, Tasmania, January 1993, p.30.

Chapman, F. & Crespin, I., 1934. The palaeontology of the Plantagenet Beds of Western Australia. J. Roy. **Soc. W. A.** 20: 103-136.

Churchill, D. M., 1961. The Tertiary and Quaternary vegetation and climate in relation to the living flora in southwestern Australia. Univ. W.A. **Science PhD Thesis** (unpublished).

Churchill, D. M., 1973. The ecological significance of tropical mangroves in the Early Tertiary floras of southern Australia. Geol. Soc. Aust. **Spec. Publ.** 4: 79-86.

Clifford, H. T. & Constantine, J., 1980. **Ferns, Fern Allies and Conifers of Australia.** University of Queensland Press, St Lucia, 150 pp.

Hocking, R. M. & Cockbain, A. E., 1990. Regolith. In, Geology and Mineral Resources of Western Australia. **W. A. Geol. Surv. Mem.** 3: 591-602.

Hos, D., 1975. Preliminary investigations of the palynology of the Upper Eocene Werillup Formation, Western Australia. J. Roy. Soc. W. A. 58: 1-14.

Lange. R. T., 1978. Some Eocene leaf fragments comparable to Proteaceae. **J. Roy. Soc. W. A.** 60: 107-114.

McNamara, K. J. & Scott, J. K., 1983. A new species of Banksia (Proteaceae) from the Eocene Merlinleigh Sandstone of the Kennedy Range, Western Australia. **Alcheringa** 7: 185-193.

Milne, L. A., 1988. Palynology of a Late Eocene lignitic sequence from the western margin of the Eucla Basin, Western Australia. **Ass. Australas. Palaeontols. Mem.** 5: 285-310.

Veevers, J. J., Powell, C. McA. & Roots, S. R., 1991. Review of seafloor spreading around Australia. 1. Synthesis of the patterns of spreading. **Aust. J. Earth Sci.** 38: 373-389.

Wilde, S. A. & Backhouse, J., 1977. Fossiliferous Tertiary deposits on the Darling Plateau, Western Australia. **W. A. Geol. Surv. An. Rept.** 1976: 49-52.

STETHACANTHID SHARK TEETH FROM THE PERMIAN HOLMWOOD SHALE FORMATION (FOSSIL CLIFF MEMBER), IRWIN RIVER DISTRICT, WESTERN AUSTRALIA.

Steve Daymond, 68 Osprey Drive, Yangebup, W. A.

Introduction

The richly fossiliferous Lower Permian Fossil Cliff Member of the Holmwood Shale Formation, at Fossil Cliff, is Western Australia's longest collected fossil locality. Its abundant, diverse fauna of brachiopods, crinoids, corals, bivalves, rare ammonoids and even rarer trilobites has drawn both amateur and professional palaeontologists, geologists and geology students since 1849 (Clarke et al., 1951).

Vertebrate fossils from the formation, however, are extremely rare. A tiny, undescribed stethacanthid shark tooth was discovered by a geology student from the University of Western Australia sometime before 1938 and is in the collection of the Geology Department of the U.W.A.. All other known stethacanthid material has been collected by the author in 1985 and 1990.

An abraded stethacanthid tooth (WAM 85.10.1) was discovered at Fossil Cliff in 1985 and subsequently donated to the Western Australian Museum. Five years, and ten further visits, were to pass before two more specimens (one beautifully complete) were discovered along with a possible Helodus sp. tooth crown and two actinopterygian fish scales. This, together with some microscopic fish teeth recently discovered by a U.W.A. doctoral student, is the total of known vertebrate specimens from the Permian of the Perth Basin.

The two stethacanthid teeth (Pl.1 a-d, h-i) were discovered within five centimetres of each other and are most likely from the same individual.

The specimen WAM 85. 10. 1. was discovered in situ while the two other teeth were discovered further upstream, in a large block (from the same layer) that had fallen from its original position some 15 feet above river level.

Locality

Fossil Cliff is located on the north branch of the Irwin River, approximately 400 kilometres N.N.E. of Perth in the northern Perth

PERMIAN STETHACANTHID SHARK TEETH (Cont.)

Basin. The Irwin River is normally dry, flowing only for short periods after heavy rain.

The Fossil Cliff Member outcrops on the west bank of the river and extends for approximately 200 metres upstream.

Stratigraphy

The Irwin sub-basin contains a Permian sequence about 2600 metres thick (Playford et al., 1976). The Fossil Cliff Member consists of layers of dark siltstone, sandy siltstone and shales with lenticles of limestone. Narrow secondary bands of gypsum and jarosite are also present. The teeth were discovered in the sandy siltstone facies immediately above the hard, grey limestone facies. The first tooth (Pl.1 e-g) was discovered just above river level at the southern end of the exposure while the other teeth were discovered 50 metres upstream. The strata at Fossil Cliff has a north-south dip of about 10 degrees. The Holmwood Shale Formation, of which the Fossil Cliff Member is the uppermost section, conformably overlies the glacial Nangetty Formation and is conformably overlain by the near-shore marine sediments of the High Cliff Sandstone.

The type section of the Fossil Cliff Member at Fossil Cliff is 27 metres thick.

The associated ammonoid fauna (Metalegoceras kayi) indicates that the Fossil Cliff Member is of upper-most Sakmarian (Sterlitamakian) age (Playford et al., 1976).

Environment of Deposition

Recent work in the area (D. Ferdinando pers. comm.) has supported the hypothesis that the Irwin sub-basin sediments were deposited in a barred basin (Clarke et al., 1951). During Fossil Cliff time the water was very shallow, perhaps no more than 20 metres deep. The sea-bed had only a very slight gradient so water depth changed very little over the entire basin. Most of the sea-bed was disaerobic and either barren of life or containing a dwarfed fauna. The areas where the Fossil Cliff sediments were deposited (e.g. Fossil Cliff and Beckett's Gully) represent areas of slightly higher seabed which provided aerobic conditions for the proliferation of fauna. Fluctuating sea levels caused by the gradual warming of the oceans at the end of the glacial period led to the deposition of alternating aerobic and disaerobic sediments.

The limestone lenses in the formation represent depressions in the sea-bed where calcareous material was washed in.

Material

<u>Stethacanthus</u> sp.
(Pl.1 a-i)

The only complete tooth collected (Pl.1 a-d) is rather similar to one described from the Carboniferous (Namurian) Bear Gulch

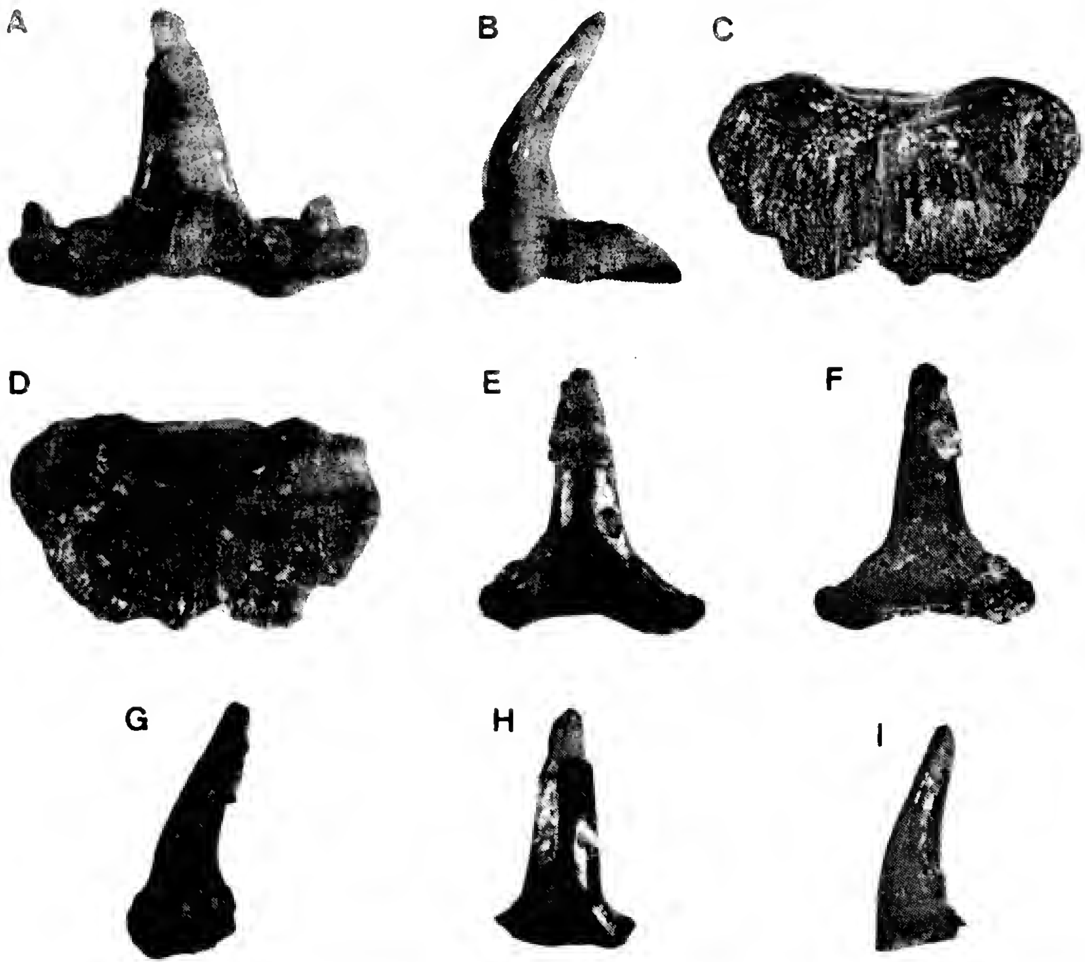


PLATE 1. <u>Stethacanthus</u> sp.: A, complete tooth, labial view; B, lateral view; C, ventral view of base; D, dorsal view; E, WAM 85.10.1, labial view; F, lingual view; G, lateral view; H, cusp, labial view; I, lateral view. All figures x 2.

PERMIAN STETHACANTHID SHARK TEETH (Cont.)

Limestone of Montana, U. S. A. (Lund 1985, fig.8d), and also, to a lesser degree, one described from the Visean of Queensland (Turner 1990, fig.3) although it is larger with a proportionally deeper base. The basal surface of the tooth is 24mm x 14mm compared to 15mm x 7mm for, surprisingly, both the Bear Gulch and the Queensland material. The labial edge of the ventral surface of the base has two prominent bosses (Pl.1 c), one under each of the intermediate cusps on each side of the main cusp. There are also two prominent bosses on the dorsal surface of the lingual edge of the base. The height of the main cusp is 15mm above the labial base. The labial surface of the cusp is smooth with striations being restricted to the lateral basal sides of the cusp where they curve around and down towards the midline of the lingual surface. The two lateral cusps are directed only slightly outwards with the broken bases of the intermediate cusps between these and the main cusp. The concavity on the central labial edge of the base is much deeper than that of the Queensland specimen and shows more similarity, in this regard, to the Montana specimen. This concavity was the location of the main cusp of the succeeding tooth. The prominent bosses on the ventral and dorsal surfaces of the base evolved to guarantee proper spacing between successive teeth in the replacement tooth families and are a more advanced feature than the simple labial lip on the base of the Queensland specimen (J. Long, pers.comm.).

The cusp in Plate 1, (h-i), is a main cusp broken from its base. Its height is identical to that of the main cusp of the complete specimen, however, it is a slightly more elongate tooth.

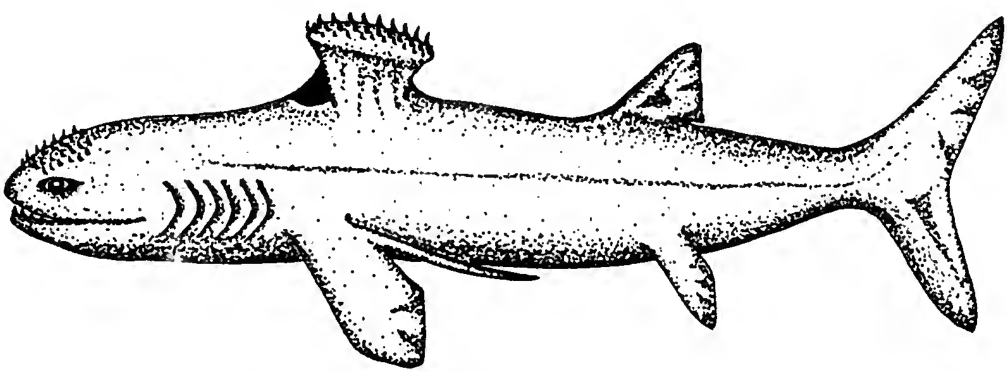


FIGURE 1. Stethacanthus sp.: Possible life reconstruction (after Zangerl, 1981).

The abraded tooth in Plate 1, (e-g), is the original specimen discovered in 1985 (WAM 85.10.1). Most of the base and side cusps have been worn off, although there are remnants of the intermediate cusps on either side of the main cusp. The total height of the tooth is 18mm.

Discussion

Stethacanthid sharks were unusual sharks of the Palaeozoic (fig. 1). They were provided with a most spectacular specialisation: a characteristically shaped spine/fin assembly some distance behind the head (Zangerl, 1981). The spine was not a typical fin spine as it lacked the usual coating of orthodentine and was, instead, coated with trabecular dentine. The spine was attached to a strange structure, located behind, which consisted of a "brush" of fine fibres that radiated upward and backward. The top of this "brush" was flat and covered by a large number of monocuspid dermal denticles as was the top of the head. This structure was earlier thought to be an adaptation for increased manoeuvrability (Lund, 1974). However, later studies have led to the belief that it was possibly associated with sexual display behaviour, as the "brush" only occurs in sexually mature males, or possibly for use in a threat posture - the top of the head and spine assembly simulating tooth-studded jaws of a very large mouth (Zangerl, 1981).

The specimens reported in this article are the first record of this strange shark from the Permian of Australia. Stethacanthids are known from the Permian of Oman (J. Long, pers.comm.), however, all other records of Stethacanthus are from the Carboniferous.

Acknowledgements

I would like to thank Dr. John Long of the Western Australian Museum for his encouragement, his comments on this article and for the loan of specimen WAM 85. 10. 1. Also Darren Ferdinando from the Geology Dept., University of Western Australia, for his interest, and providing information on the depositional environments of the Irwin sub-basin sediments.

References

Clarke, E. de C., Prendergast, K. L., Teichert, C., and Fairbridge, R.W., 1951. Permian succession and structure in the northern part of the Irwin Basin, Western Australia. **Jour. Roy. Soc. West. Aust.** 35: 31-84.

Lund, R., 1974. Stethacanthus altonensis (Elasmobranchii) from the Bear Gulch Limestone, Montana. **Ann. Carnegie Mus.** 45: 161-178.

PERMIAN STETHACANTHID SHARK TEETH (Cont.)

Lund, R., 1985. Stethacanthid elasmobranch remains from the Bear Gulch Limestone (Namurian E2b) of Montana. **Am. Mus. Novit.** 2828: 1-24.

Playford, P. E., Cockbain, A.E., and Low, G. H., 1976. Geology of the Perth Basin, Western Australia. **Geol. Surv. West. Aust. Bull.** 124.

Playford, P. E., Cope, R. N., Cockbain, A. E., Low, G. H., and Lowry, D. C., 1975. Phanerozoic. In Geology of Western Australia. **Geol. Surv. West. Aust. Mem.** 2: 223-432.

Turner, S., 1982. Middle Palaeozoic elasmobranch remains from Australia. **J. Vert. Paleo.** 2: 117-31.

Turner, S., 1990. Early Carboniferous shark remains from the Rockhampton District, Queensland. **Mem. Qld. Mus.** 28: 65-73.

Zangerl, R., 1981. Chondrichthyes 1. Paleozoic Elasmobranchii. In H.P. Shultze, ed. **Handbook of Paleoichthyology** 3a. Fischer Stuttgart, New York.

IN THE NEWS

JAPAN'S OLDEST BIG MAMMAL FOSSIL FOUND IN FUKUOKA

Fukuoka - Fossils excavated in April, 1992 from an exposed layer near Sarutatoge Pass in Munakata, Fukuoka-ken, have been determined to be the jawbones and femur from a large (2 metres tall at the shoulder) herbivorous mammal of the Pantodonta family that lived 45 million years ago, in the Middle Eocene period.

The oldest known mammalian fossil in Japan, about 90 million years old from the Middle Cretaceous period, is a lower jawbone from an insectivorous animal about the size of a rat that was discovered in Mifunemachi, Kumamoto-ken.

This latest find, however, is the oldest in Japan of a large mammal, and the first ever discovery of a Pantodonta. The fossils include part of a lower jawbone with canine and incisor teeth still embedded, and an upper jawbone with a 15 cm long canine tooth and fragments of molar teeth. There was also a femur weathered down to 23 cm in length.

Harutaka Sakai, an assistant professor at Kyushu University, discovered the fossils, while analysis and identification of the evidence was conducted by Yukimitsu Tomita, chief researcher at the National Science Museum in Tokyo. Tomita, noting the size of the canines and the presence of gaps behind the canines, concluded that the fossils were of a Pantodonta. This family of mammals is closely related to the Artiodactyla (modern deer and cattle) and Perissodactyla (modern horses), and existed from the end of the Age of Dinosaurs 65 million years ago up to about 30 million years ago. They appear to have first existed in Asia, and fossils have been found as far away as Europe and North America. The animal found in Fukuoka-ken appears to be a close cousin of the coryphodon, a tapir-like animal whose fossils have been found in large numbers in China and Mongolia.

The site where the fossil was found is the lowest (oldest) layer of the Noogata formation, a part of the Chikuho coal field, and scientists have dated it at 45 million years ago. Immediately below that is the Kagogan formation of the Cretaceous period. The layer containing the fossils is composed of sedimentary accumulations.

According to Sakai, this find further confirms that there was a time before formation of the Japan Sea when Japan was contiguous to the mainland.

Report in the Daily Yomiuri, 6th March, 1993.

THE GREAT DEVONIAN CANOWINDRA FISH-KILL

Alex Ritchie, Australian Museum, Sydney, N.S.W.

Historical background

The Canowindra site was first discovered in 1956 by workmen improving a bad bend on a country road between Canowindra and Gooloogong, in central west N.S.W. A bulldozer turned over a large slab of rock with numerous impressions of fossils on its undersurface. The slab was pushed aside to the fence line for safety and a note sent to the Australian Museum in Sydney.

Some time later Harold Fletcher, Museum Palaeontologist, visited the site accompanied by a friend, Dr. Ted Rayner from the N.S.W. Mines Department. The fossil slab, one of the most remarkable discoveries of its kind from anywhere in the world, was immediately recovered and removed to Sydney where, since 1966, it has been a centre-piece attraction in the Museum's Hall of Fossils. It bears the evidence of a mass-kill event that took place some 360 million years ago, in Late Devonian times (the 'Age of Fishes').

The undersurface of the Canowindra slab bears the impressions or natural moulds of some 114 Late Devonian fishes, most of them complete. Four types of long-extinct fishes are present - Bothriolepis (abundant); Remigolepis (abundant); Groenlandaspis (rare); and Canowindra grossi (rare). Some smaller slabs recovered at the same time brought the total number of fish recovered in 1956 to around 200. By the time the original slab was recovered both the road surface and margins had been graded and the actual horizon from which the slab of fossilized fish had come could not be pinpointed. From 1956 until the early 1980's the study of the Canowindra fish fauna was carried out by the late Professor Sherbon Hills of Melbourne University.

After Professor Hills gave up working on the Canowindra fauna, Palaeontology staff from the Australian Museum visited the site several times in an attempt to locate the fish layer, without success - heavy earth-moving equipment being clearly necessary. On several occasions provisional plans were made to excavate the site, using Army and/or volunteer assistance together with heavy equipment, but for various reasons these fell through.

In late 1992 Dr. Alex Ritchie was invited to talk to Canowindra Rotary on the "Great Canowindra Fish-Kill". This visit stimulated local interest in the site and its potential. A subsequent

THE GREAT DEVONIAN CANOWINDRA FISH KILL (Cont.)

approach to the local council, Cabonne Shire, for the use of heavy earth-moving equipment, was approved and a preliminary investigatory dig carried out at Canowindra in January 1993.

Results of the 1993 preliminary dig at Canowindra

The exploratory dig at Canowindra was an enormous success with results exceeding expectations, thanks to the use of a 22 tonne excavator and the skill of its driver, Fred Fewings.

The rich fossil fish layer was relocated on the inner curve of the road and uncovered up the embankment to the fence line, a distance of about 20 metres. It almost certainly continues into the neighbouring paddock but how far it extends up the hillside is mere guesswork at this stage.

Along this stretch the fossil layer is crammed with fishes, every bit as rich as the original slab found in 1956. The layer almost certainly extends under the existing gravel road surface and could be excavated there also.

Some 300+ specimens were recovered in 2 days of digging. They include some remarkable and unexpected treasures and confirmed what we have long suspected. On the evidence of the latest dig

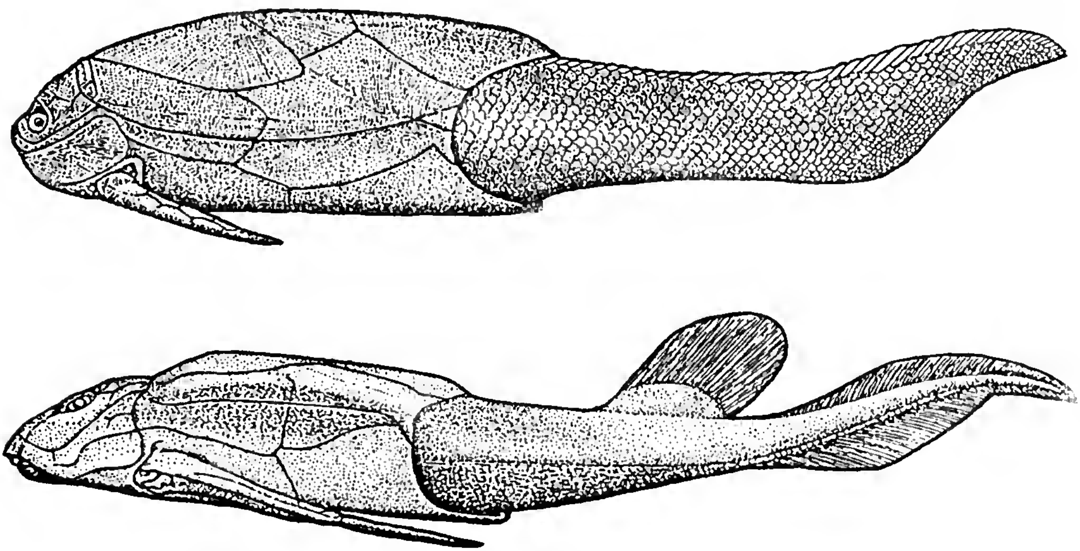


Figure 1. Two very common antiarchs (armoured fish) found at Canowindra: top, Remigolepis; bottom, Bothriolepis.

many hundreds, possibly thousands, of fishes are present on this one layer, readily accessible and awaiting excavation.

The Canowindra Fish Bed is, without doubt, one of the richest fossil fish sites discovered anywhere in the world, both for the quantity and quality of the specimens. It is a world-class site

The rock layers dip to the west at a shallow angle. Using an excavator it should be comparatively easy to expose and remove a large area of the fish layer, at least 100 sq.m., possibly more. The fossils are on the underside of the massive slabs and are thus not visible until the blocks are turned over and cleaned. So the fish-layer must be lifted, block by block, by the excavator. Careful supervision and willing helpers will be required to plot, orient and mark each block for subsequent reassembly and analysis elsewhere.

Most of the new specimens recovered were, as expected, the common armoured fishes, Bothriolepis and Remigolepis. However, we also found 4 new specimens of crossopterygian fish, previously known only from a single specimen on the original slab. Two were the same size as the original specimen; two were giants which must have reached 1.5 - 2 metres in length. The four new crossopterygians differ from the original form, Canowindra grossi, and probably represent a species new to science.

We also recovered two new specimens of Groenlandaspis, a third type of armoured fish known to be present at Canowindra but represented previously only by two tiny specimens on the original slab. The new specimens are much larger, at least as large as some finds from Devonian rocks of Antarctica and Victoria which suggests that the first two specimens were probably juveniles.

It is now clear that the burial, preservation and discovery of the Canowindra fish assemblage was the result of a unique combination of circumstances, a mass-kill phenomenon which took place during a very short period of time (weeks or days) about 360 million years ago.

A small lake or pool inhabited by thousands of small and large fishes dried up completely during a drought. Everything living in it was killed off - juveniles, half-grown and fully adult specimens, all mixed up. The Canowindra site provides a unique opportunity to carry out a detailed population study on a Late Devonian assemblage of fishes.

THE GREAT DEVONIAN CANOWINDRA FISH KILL (Cont.)

Now that we have successfully relocated the Canowindra fish-layer, the magnitude of the deposit (and the problem of investigating it) is clear - there may be thousands of complete, closely-packed individuals within an area which is easily excavated and is adjacent to a road. In January we resisted the temptation to dig too much and extracted blocks weighing 3 or 4 tonnes where the fish layer met the surface. Results from the small area sampled indicate that many exciting fossil treasures await discovery.

We plan to proceed, in mid-1993, with a large scale dig at Canowindra but this will need careful co-ordination and planning to ensure success. At present plans are being made to carry out this project in July, given sufficient equipment and logistical support from the local council and community.

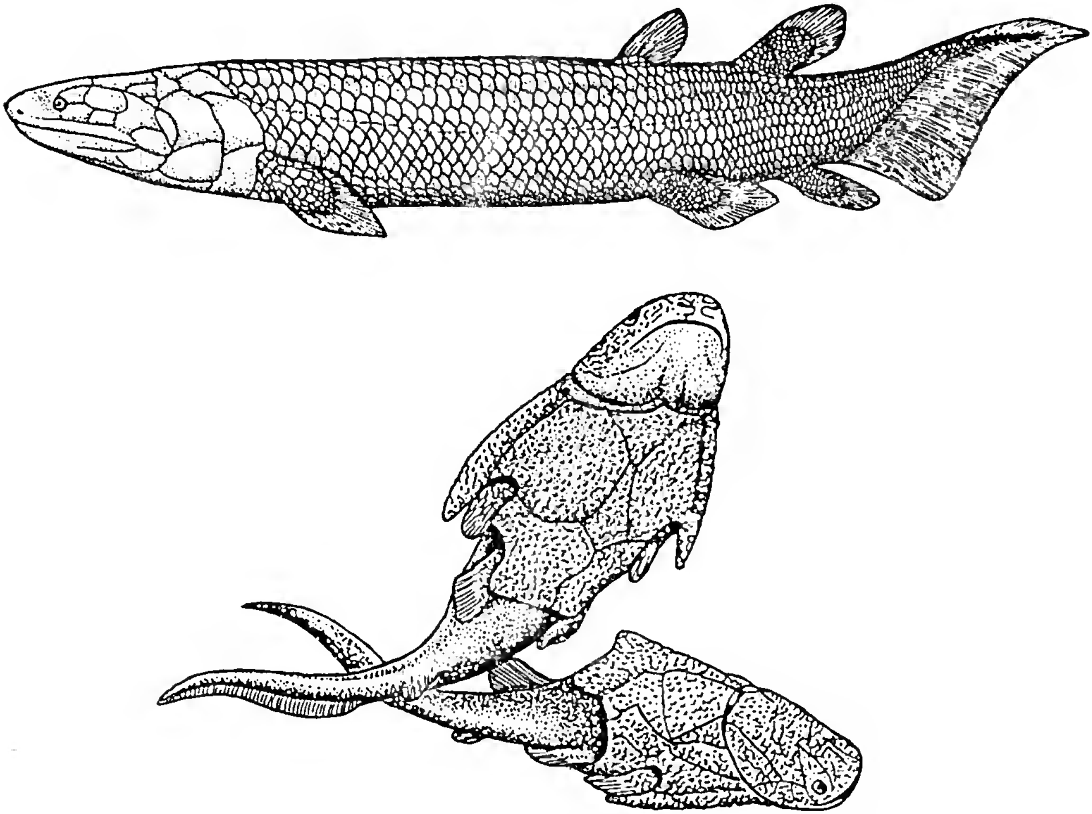


Figure 2. Two very rare fish found at Canowindra: top, the crossopterygian (lobe-fin) Canowindra; bottom, the arthrodire (armoured fish) Groenlandaspis.

The logistic problems and costs of a major dig to collect, prepare and store large numbers of slabs covered in fish fossils of great scientific importance present a major challenge. Given the high costs of specimen storage in inner city areas, the removal of this bulk material to Sydney is completely impracticable. The Australian Museum is already encountering difficulty and increasing costs in storing large, bulky or heavy specimens.

Alternative solution

There is an obvious alternative solution to the Canowindra problem - to locate, in or near Canowindra, a suitable site with adjacent storage space, which could also be developed as a local museum. Land in the area is abundant and cheap. One ideal potential site, currently owned by a state authority, has already been identified by the local community. Given suitable storage space and facilities in, or near, Canowindra, there is no need to bring large quantities of material back to Sydney.

The material from the Canowindra site could thus form the basis of a superb little local museum centred on the Canowindra site and featuring the "AGE OF FISHES".

Such a museum would not be a cheap undertaking. It would only be possible given space plus sufficient community or state support and funding and/or corporate and private sponsorship. Initial responses indicate that these are likely to be available.

There is a similar museum in Canada, at Miguashua in the Gaspe Peninsula area of eastern Quebec, which is extremely successful and a major tourist attraction. This local museum displays a wide range of beautifully preserved Late Devonian fish and plant fossils from sites around Miguashua, which are about the same age as the Canowindra site. **The Miguashua Museum attracts about 45,000 visitors a year!**

We may not have spectacular fossils such as dinosaurs in N.S.W., but sites such as "The Great Devonian Canowindra Fish Kill", if properly presented, tell an equally fascinating story.

OVERSEAS COLLECTOR WISHES TO EXCHANGE FOSSILS

J. B. Hopton, 11 Hornbeam Close, Hedge End, Hampshire, England, SO34QN, wishes to correspond with members with a view to arranging postal exchange of fossils and/or palaeontological information. For exchange, Mr Hopton has ammonites, gastropods, brachiopods, bivalves, corals & echinoids, mainly from the Jurassic and Cretaceous.

K .S. W. CAMPBELL SYMPOSIUM

Held at The Australian National University, Canberra, A.C.T., 8-10 February, 1993.

A two-day symposium, dinner and one-day field trip to the Siluro-Devonian of the Yass-Taemas area held at the ANU to honour the retirement of Professor Ken Campbell from the Chair of Geology after many years as Lecturer, Reader and finally Professor. The papers were presented in the re-located Geology Department at ANU (formerly the Botany School), and the Conference dinner was held at Burgmann College. The Symposium was organised by the Australasian Association of Palaeontologists.

Palaeontologists from all over Australia, and from England, New Zealand, Canada and the United States of America presented papers on a very wide range of topics, reflecting the wide research interests of Ken Campbell. A brief resume of the papers presented gives some idea of the exciting developments in palaeontology at the present time - perhaps the most exciting time in our discipline for decades (almost paralleling Eldredge & Gould's theory of "Punctuated Equilibria" with sudden changes following long periods of stasis).

The first papers focussed on lungfish, one of Ken's current specialities. Moya Smith, from Guy's Hospital,London, in collaboration with Russian and French colleagues, presented new data about the development and ontogeny of teeth and denticles in lungfish. This was a beautifully clear and well-illustrated paper on a subject about which the writer of this report knew nothing (as was the case with many of the papers) but which communicated its results in a most interesting and easily comprehended way. Pridmore & Barwick (Canberra) gave new data on those parts of the skeletons of lungfish other than the skulls, which latter have dominated papers on this subject for many years. John Long, from the West Australian Museum, continued this emphasis on post-cranial skeletons, with a characteristically well-argued paper about material from Mt. Howitt in Victoria. Then Charles Marshall, now at UCLA in Los Angeles, covered about twice as much subject matter as the other presenters with his quick-fire presentation on lungfish phylogeny. Susan Turner, Queensland Museum, focussed our attention on the minutiae of vertebrates with a paper on Early Carboniferous microvertebrates from Central Queensland. Gavin Young, one of our hosts from the AAP Committee and AGSO (formerly BMR for those not up with the latest name changes), shifted our attention from lungfish to sharks, with a paper on Devonian sharks' teeth from Antarctica. The vertebrate papers concluded with David Ride talking about a new genus of rat-kangaroo, Jackmahoneya, named after (guess who?) Jack Mahoney.

After lunch, the emphasis shifted to genetics and evolution, an area in which Ken will be continuing research with colleagues at the Centre for Molecular Structure and Function, Research School of Biological Sciences, ANU. George Miklos, from the Centre, gave a fascinating paper on the rapid evolution of morphological and neuronal complexities, which may seem far removed from palaeontology, but in fact is not. The "Molecular Lego" approach taken by George and Ken to the interpretation of functional morphology has opened up new vistas, quite different from the taxonomic and neo-Darwinian scenarios we have become accustomed to over many decades. Genes from the most primitive organisms have been found to be identical with genes in the human chromosome, and to still carry out the same function as they do in the very simple forms of life in which they were first identified. Barry Webby's paper looked at the evolutionary history of Palaeozoic Stromatoporoidea from the point of view of inferred soft structure related to the calcareous skeleton, and raised some fundamental questions about previous theories. Brian Chatterton, a former colleague of Ken's from his "trilobite days", reminded us of the fascination of these extinct arthropods as he meticulously analysed the characteristic of enrollment of trilobites, and illustrated his points with mouthwatering illustrations of beautifully preserved specimens. The Palaeozoic papers continued with presentations

on conodonts by Robert Nicoll; graptoloids by Chris Jenkins and stromatoporoids by Alex Cook.

The second day's lectures began with further Palaeozoic oriented subjects - John Jell on biostratigraphy of the Northern Tasman Fold Belt; John Talent reporting on work at Macquarie University on Devonian foraminiferans and conodonts from Cowombat in Victoria; Glen Brock on Early Devonian brachiopods; Theresa Winchester-Seeto on chitinozoans from the Devonian of Eastern Australia; Neil Archbold on a new Permian spiriferid genus and some generalised papers on palaeobiogeography (Shi & Archbold; Dickins) and facies analysis (Pohler).

After lunch we finally said farewell to the Palaeozoic, where Ken's research interests had focussed for many years, and heard a number of papers on Mesozoic and Cainozoic subjects. Samir Shafik (AGSO/BMR) spoke on nannofossil records from off-shore Jurassic sediments and the Albian Carnarvon Terrace, NW Australia. Tom Darragh (Museum of Victoria) reported on Paleocene bivalves from the Pebble Point Formation of Victoria. The conference sessions concluded with four papers on foraminifera, and Ken indicated that he had worked on these little beasts in his very early days, before moving on to "greater" things. Neville Alley reinterpreted foraminiferal and palynological evidence from the Eocene of the Eucla Basin; Graham Moss convincingly related foraminiferal turnover in the Oligocene of southern Australia to prominent climatic changes at that time. David Almond presented data concerning the Late Quaternary foraminiferal record in the Great Australian Bight. In a most entertaining and stimulating paper, Brian McGowran from the University of Adelaide poured scorn on the timid souls who refuse to make palaeoenvironmental inferences from fossil data, and proceeded to draw some clear-cut conclusions from Miocene planktonic foraminifera from Lakes Entrance about transformations in the mid-latitude ocean at that time. Brian's argument was well-buttressed with correlations with a whole range of faunal characteristics.

I did not go on the excursion, but was at the very well-attended dinner in Burgmann College, where speakers spoke of Ken's outstanding record as a teacher and research worker in a whole range of palaeontological sub-disciplines, as well as in biology and systematics. It was a fitting way to mark the retirement (but obviously not the end of research!) for one of Australia's most distinguished geologists and palaeontologists.

John Neil, 22nd February, 1993.

IN THE NEWS (CONT.)

SPECIFIC NAME OF NEW FOSSIL ECHINOID ACKNOWLEDGES FCAA MEMBERS

The type species of a new genus of brissid echinoid from the Late Oligocene Jan Juc Formation, Waurn Ponds Limestone Member, has been named after the four FCAA echinoid collectors asociated with its discovery.

Named <u>Apoxypetalum chenjafra</u> in a recent paper by Dr K. J. McNamara (Western Australian Museum, Perth), the specific name <u>chenjafra</u> (pronounced "ken-ja-fra") is an arbitrary combination of the first names of <u>Ch</u>ris Ah Yee, <u>En</u>id Holmes, <u>Ja</u>nice Krause and <u>Fra</u>nk Holmes.

The four collectors discovered the new genus on the exposed base of an old limestone quarry at Waurn Ponds, near Geelong, Victoria, in June, 1990. Having realised it was more than likely a new genus (at least, one not recorded in Australia), they forwarded specimens to Dr McNamara for identification and possible description.

Although Chris Ah Yee and Janice Krause, in particular, had collected at the quarry on numerous occasions, the new genus, being confined to the basal bed, had previously

IN THE NEWS (cont.)

remained unnoticed. This was probably because of its small size, the seasonal build up of silt on the quarry floor and the growth of grass and weeds. However, once discovered, a systematic search by the four collectors uncovered approximately fifty specimens as well as two other brissid species.

Reference: McNamara, K. J., 1993. A new genus of brissid echinoid from the Upper Oligocene of Victoria. Proceedings of the Royal Society of Victoria 105(1): 39-48.

SCHOOLCHILDREN FIND EXTINCT BIRD'S EGG

Three Western Australian schoolchildren aged six, eight and nine have dug up a rare fossilised egg believed to be from a species of the giant elephant bird of Madagascar, Aepyornis.

The egg, 80.5cm in circumference and 30cm long, was found last Christmas near Cevantes, 180km north of Perth, Western Australia. However, although the children took it to school as part of a "show and tell" it was not shown to the W.A. Museum until mid March.

Although the flightless bird Aepyornis, a giant 2.5 to 3 metre high distant relative of the Emu, became extinct in Madagascar only about 300 years ago, Dr. John Long, curator of vertebrate palaeontology at the Western Australian Museum believes the egg is more likely to be thousands rather than hundreds of years old as it was found a kilometre inland among ancient sandunes that once marked the shoreline. It is considered the egg floated across the Indian Ocean from Madagascar, a distance of 6,000 kilometres. A smaller egg from the elephant bird was found in 1930 south of Scott River near Augusta, 275km south of Perth.

The W.A, Museum is negotiating to buy the specimen with money from a benefactor.

Based on an AAP report in the Herald Sun and an article by Ian Anderson in "New Scientist", 27th March, 1993.

LETTER TO THE EDITOR

The following is an edited extract of a letter from Stevén Avery, 24 Werona Ave, Werrington, N.S.W. 2747, advising of the discovery of new insect species from Talbragar. Unfortunately, lack of space precludes publication of the full text.

> "Only one insect has been officially described from the Talbragar Fish Beds, N.S.W. Recent discoveries by myself have yielded the possibility of at least four new winged species ranging in size from 5mm. to 30mm. Over 30 specimens of one species, the smallest, have been found. The material is now being studied by experts, as I am unable to describe and illustrate them myself, not being familiar with insects. When more is known, hopefully in the near future, I will supply further details.
>
> Dr Alex Ritchie and Bob Jones from the Australian Museum, Sydney, invited me to inspect their Talbragar specimens recently and to their delight three of the common species were found. The insect finds are no surprise to me as I believe no one has bothered to look before. They are virtually invisible with no colouring and are only visible with the naked eye in the right lighting conditions or by means of magnification.
>
> These insects may well assist in determining what type of environment existed at Talbragar during the Jurassic."

He goes on to state that he tends to disagree with Sheila Bennetts' view of the environment during the deposition of the Talbragar Beds (Bulletin 39, p.36), favouring in principle that given by Colin Chidley (Bulletin 38, p.17).